

Numerical methods for experimental design of large-scale linear ill-posed inverse problems

E. Haber, L. Horesh & L. Tenorio

Abstract

While experimental design for well-posed inverse linear problems has been well studied, covering a vast range of well-established design criteria and optimization algorithms, its ill-posed counterpart is a rather new topic. The ill-posed nature of the problem entails the incorporation of regularization techniques. The consequent non-stochastic error introduced by regularization, needs to be taken into account when choosing an experimental design. We discuss different ways to define an optimal design that controls both an average total error of regularized estimates and a measure of the total cost of the design. We also introduce a numerical framework that efficiently implements such designs and natively allows for the solution of large-scale problems. To illustrate the possible applications of the methodology, we consider a borehole tomography example and a two-dimensional function recovery problem.

keywords: experimental design, ill-posed inverse problems, sparsity, constrained optimization.